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Applicant(s): VICTOR COMPANY OF JAPANVICTOR CO OF JAPAN LTD
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Title: APPARATUS AND METHOD FOR CORRECTING DEFECTIVE PIXEL
Abstract:
PROBLEM TO BE SOLVED: To provide an apparatus for correcting defective pixels, capable of satisfactorily correcting even the defective pixels in a low defect degree.
SOLUTION: An interpolating data calculator 40 calculates interpolating data HD1 to HD3 by using a plurality of paired pixels disposed at symmetrical positions of peripheral pixels (a) to (f) at a noted pixel (x) as a center. An interpolating direction deciding circuit 30 decides an interpolating direction by using the plurality of paired pixels. A defective pixel deciding circuit 10 calculates the difference of data of the noted pixel (x) and the data HD1 to HD3, and decides that the pixel (x) is defective if all the differences are larger than a threshold T.
An output data selector 50 outputs the interpolating data of the interpolating direction decided by the circuit 30 of the data HD1 to HD3 if the pixel (x) is decided to be defective.
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(54) Title of the invention: Apparatus and method for correcting defective pixel

(57)Abstract:

Problem to be solved: To provide an apparatus for correcting defective pixels, capable of satisfactorily correcting even the defective pixels in a low defect degree.

Solution: An interpolating data calculator 40 calculates interpolating data HD1 to HD3 by using a plurality of paired pixels disposed at symmetrical positions of peripheral pixels (a) to (f) at a noted pixel (x) as a center. An interpolating direction deciding circuit 30 decides an interpolating direction by using the plurality of paired pixels.

A defective pixel deciding circuit 10 calculates the difference of data of the noted pixel (x) and the data HD1 to HD3, and decides that the pixel (x) is defective if all the differences are larger than a threshold T. An output data selector 50 outputs the interpolating data of the interpolating direction decided by the circuit 30 of the data HD1 to HD3 if the pixel (x) is decided to be defective.

[Claims]

[Claim 1]

A defective pixel compensator that amends a defective pixel contained in a picture that consists of a plurality of pixels, including an interpolation data calculation circuit that computes a plurality of interpolation data using a plurality of picture element pairs that are in a symmetric position focusing on the mentioned above pixel having among pixels located around pixel having in the mentioned above a plurality of pixels, an interpolation direction deciding circuit that judges an interpolation direction using the mentioned above a plurality of picture element pairs, computing difference of data of the mentioned above pixel having, and a plurality of the mentioned above interpolation data, respectively, and each of the difference is compared with a predetermined threshold, a defective pixel deciding circuit will judge that is the mentioned above pixel having normal if one

of difference is below the mentioned above threshold, and will judge that is the mentioned above pixel having poor if all the difference is larger than the mentioned above threshold, when judged with the mentioned above pixel having being normal by the mentioned above defective pixel deciding circuit, an output data selection circuit that outputs interpolation data of an interpolation direction judged by the mentioned above interpolation direction deciding circuit among the mentioned above a plurality of interpolation data when data of the mentioned above pixel having is outputted and it is judged with the mentioned above pixel having being poor by the mentioned above defective pixel deciding circuit.

[Claim 2]

A defective pixel correcting method that amends a defective pixel contained in a picture that consists of a plurality of pixels, including an interpolation data calculation step that computes a plurality of interpolation data using a plurality of picture element pairs that are in a symmetric position focusing on the mentioned above pixel having among pixels located around pixel having in the mentioned above a plurality of pixels, an interpolation direction determination step that judges an interpolation direction using the mentioned above a plurality of picture element pairs, computing difference of data of the mentioned above pixel having, and a plurality of

the mentioned above interpolation data, respectively, and each of the difference is compared with a predetermined threshold, a defective pixel determination step will judge that is the mentioned above pixel having normal if one of difference is below the mentioned above threshold, and will judge that is the mentioned above pixel having poor if all the difference is larger than the mentioned above threshold, when judged with the mentioned above pixel having being normal by the mentioned above defective pixel determination step, an output data selection step that outputs interpolation data of an interpolation direction judged by the mentioned above interpolation direction determination step among the mentioned above a plurality of interpolation data when data of the mentioned above pixel having is outputted and it is judged with the mentioned above pixel having being poor by the mentioned above defective pixel determination step.

[Detailed description of the invention]

[0001]

[Field of the invention] This invention relates to the defective pixel compensator and method of amending the defective pixel (defect pixel) contained in the picture of a plurality of pixels by which 2D array was carried out, and especially, even if a poor grade is a

small defective pixel, it relates to the defective pixel compensator and method of amending well.

[0002]

[Description of the prior art] For example, like the image data outputted from the solid state image pickup device, in the picture to which 2D array of a plurality of pixels was carried out, the value of some pixels may shift from a normal value, and may serve as a defective pixel. Since a defective pixel will be recognized visually as a noise, it is necessary to amend a defective pixel to a normal pixel. As the conventional defective pixel compensator and an example of a method, the patent No. 2642261 gazette has a statement. Next, the conventional defective pixel compensator and method of a statement are explained in this gazette.

[0003] Drawing 12 is a block diagram showing the defective pixel compensator of a statement in the mentioned above gazette. The defective pixel compensator o f drawing 12 judges whether the pixel having x is amended, using 3pixel a,b, c, of the front (above) line of the pixel having x, 3pixel d, e, f of a back (below) line, as a peripheral pixel, as shown on drawing 13. It should amend noting that the pixel having x is a defective pixel if judged, it will amend using a peripheral pixel (a or f, b or e, c or d).

[0004] The data of the pixel having x is inputted into the defective pixel deciding circuit 1 in drawing 12. The defective pixel deciding circuit 1 judges whether the pixel having x is a defective pixel using the data of the pixel having x, and the mentioned below interpolation data HD. The concrete composition and operation of the defective pixel deciding circuit 1 are mentioned later. The data of peripheral pixel a-f is inputted into the peripheral pixel data selection circuit 2 and the interpolation direction deciding circuit 3 one by one. The direction that connects the interpolation direction V and the peripheral pixels c and d for the direction that connects the interpolation direction L and the peripheral pixels b and e for the direction that connects the peripheral pixels a and f for the interpolation direction R. The interpolation direction deciding circuit 3 judges any of the interpolation direction L, V, R should be chosen, generates the interpolation direction selection signal Dir, and inputs it into the peripheral pixel data selection circuit 2.

[0005] The interpolation direction deciding circuit 3 is provided with the averaging part 31, the size comparing element 32, and the interpolation direction judgment part 33. The averaging part 31 computes the average value M of the data of peripheral pixel a-f by calculating (a+b+c+d+e+f)/6. The size comparing element 32 carries out size comparison of the average value M and the data of peripheral pixel a-f, and

outputs the comparison result as a binary signal of 6 bits. The interpolation direction judgment part 33 judges any of the interpolation direction L, V, R should be chosen using a table based on the comparison result from the size comparing element 32, and outputs the interpolation direction selection signal Dir.

[0006] The peripheral pixel data selection circuit 2 chooses the peripheral pixels a, f, b, e, c, d based on the interpolation direction selection signal Dir, and outputs it as two peripheral pixel data SD1, SD2. Peripheral pixel data SD1, SD2 are inputted into the interpolation data calculation circuit 4. The interpolation data calculation circuit 4 computes interpolation data HD by calculating (SD1+SD2) / 2. This interpolation data HD is inputted into the terminal and the defective pixel deciding circuit 1 of the output data selection circuit 5. On the other hand, the data of the pixel having x (drawing upper part) is inputted into another (drawing lower part) terminal of the output data selection circuit 5.

[0007] The defective pixel deciding circuit 1 is provided with the difference value calculation part 11 and the size comparing element 12. The difference value calculation part 11 computes the absolute value (|x-HD|) of the difference of the data of the pixel having x and interpolation data HD.

The output of the difference value calculation part 11 is called the difference value ? . The predetermined threshold T is inputted into the size comparing element 12, and the size comparing element 12 carries out size comparison of the difference value ? and the threshold T, and outputs the quality decision signal S. If the difference value ? is below the threshold T and the pixel having data x has normality and the difference value ? larger than the threshold T, the pixel having x will presuppose that it is poor. If the quality decision signal S is normal and they are a low and a defect, it will be made into a high and will be inputted into the output data selection circuit 5, for example.

[0008] If normal, it will connect with the drawing upper part, according to the quality decision signal S, the output data selection circuit 5 outputs the data of the pixel having x as it is, and if poor, it will connect with the drawing lower part and it will output interpolation data HD. A defective pixel will be amended by the above to the normal pixel generated by interpolation.

[0009] Drawing 14 is an example of the original image data inputted into the defective pixel compensator of drawing 12, and shows the value of each picture element data numerically. The following explanation shows the operation that performs defective pixel amendment to 5 pixels of levels and

the range of 6 pixels of perpendiculars enclosed with a solid line. Here, the pixel Q is a defective pixel and it is assumed that it has the value 70 which the value 8 of a peripheral pixel is large and is different. All other pixels including the pixel P1 are normal pixels.

[0010] In the interpolation direction deciding circuit 3, drawing 15 is converted into binary to each pixel of the range enclosed with the solid line of drawing 14, and the result of having judged the interpolation direction according to the table of a statement is shown on the mentioned above gazette. For example, the division of the highest rung left edge part of drawing 15 is the result of receiving the pixel of the highest rung left edge part in the range enclosed with the solid line of drawing 14 that becomes value 10. To the average value M of peripheral pixel a-f of this pixel, if it is less than the average value M and is beyond O and the average value M, - shows. V, R, L of each division are interpolation directions, and pixel having is located in the position which indicated V, R, L, and they show O or - that is a large and small comparison result to the position of each peripheral pixel a-f.

[0011] Drawing 16 shows the value of the peripheral pixels a-f (namely, SD1, SD2) chosen by the peripheral pixel data selection circuit 2 by the interpolation direction judged like drawing 15, and the value of interpolation data HD computed by the

interpolation data calculation circuit 4. It is a value of interpolation data HD that is shown on the center section of each division. Into the portion of the peripheral pixels a-f that are not chosen as SD1 and SD2, it is indicated as -.

[0012] Drawing 17 shows the decision result by the defective pixel deciding circuit 1 when the threshold T is set to 60. In drawing 17, the pixel by which it judged that O is normal, and x are the pixels judged that are poor. Except all the pixel Q, since it is smaller than the threshold T, it judges that the difference value ? of the data of the pixel having x and interpolation data HD is normal, and it is judged with the pixel Q being poor since the difference value ? (=62) of the data (=70) of the pixel having x and interpolation data HD (=8) is beyond the threshold T. Drawing 18 shows the correction results of the defective pixel that is an output of the output data selection circuit 5. The pixel having data x is outputted as it is except all the pixel Q, and, as for the pixel Q, interpolation data HD is outputted instead of original picture matter data.

[0013] Drawing 19 expresses the original image data shown on drawing 14 with the size that smears away a circle black. When the value of picture element data is 100, it supposes that all the circles shown with the dashed line used as a standard are smeared away, and the area smeared away black according to the value of picture element data is changed.

This is a mimetic diagram showing the value of the original image data shown on drawing 14 with an area ratio. When printing is presented with the original image data shown on drawing 14, it is equivalent also to what was expressed in area gradation. Drawing 20 shows the correction results that show correction results and are shown on drawing 18 with the same meaning as drawing 19. The defective pixel Q is amended by the mentioned above defective pixel compensator as shown on drawing 20.

[0014]

[Problems to be solved by the invention] According to the conventional defective pixel compensator and method that were explained above, when the poor grade of the pixel Q is large, the defective pixel Q can be amended, but when the poor grade of the pixel Q is small, there is problem as shown below. As shown on drawing 21, the case where the value of the pixel Q is 40 is explained to an example.

[0015] Conversion into binary and the interpolation direction decision result corresponding to drawing 15 in the case of drawing 21 are shown on drawing 22, and the value of peripheral pixel data SD1 corresponding to drawing 16 and SD2 and the value of interpolation data HD are shown on drawing 23. In this case, the binary result of peripheral pixel a-f brings the same result as drawing 15 altogether except

for the pixel P2 that exists right above the pixel Q, and all interpolation direction decision results bring the same result. And the value of peripheral pixel data SD1, SD2 and the value of interpolation data HD bring the same result altogether except for the pixel P2 that exists right above the pixel Q.

[0016] Here, in order to judge that the small pixel of a poor grade like the pixel Q is poor and to amend it, it is necessary to make the threshold T small. Next, the decision result corresponding to drawing 17 when the threshold T is set to 30 is shown on drawing 24, and the correction results corresponding to drawing 18 are shown on drawing 25. The drawing corresponding to drawing 19 when the threshold T is set to 30, and drawing 20 is shown on drawing 26 and drawing 27. As shown on drawing 24 and drawing 25, it judges that the pixel Q is poor and it is amended. However, as shown on drawing 24, 5 pixels including the pixel P1 that is not a defective pixel will be judged as a defective pixel and as shown on drawing 25 and drawing 27, it will be the original value, shifted value, respectively.

[0017] Thus, in a conventional defective pixel compensator and method, when the poor grade tended to amend to the small pixel and made the threshold T of the quality decision small, a possibility of judging a normal pixel to be a defect (erroneous decision) became high, and there was a problem of spoiling

original picture information. Thus, since the threshold T could not be made small, there was a problem that a pixel with a poor small grade could not be amended.

[0018] This invention is made in view of such a problem and the purpose is to provide the defective pixel compensator and method of amending good, even if it is a small defective pixel.

[0019]

[Means for solving the problem] In this invention, in order to solve a technical problem of a Prior art mentioned above, (A) a defective pixel compensator that amends a defective pixel contained in a picture that consists of a pixel of plurality, an interpolation data calculation circuit (40) that computes a plurality of interpolation data using a plurality of picture element pairs which are in a symmetric position focusing on the mentioned above pixel having among pixels (a-f, a-h) located around pixel having (x) in the mentioned above a plurality of pixels, an interpolation direction deciding circuit (30) which judges an interpolation direction using the mentioned above a plurality of picture element pairs, compute difference of data of the mentioned above pixel having and a plurality of the mentioned above interpolation data, respectively, and each of the difference is compared with a predetermined threshold, a defective pixel deciding circuit (10) will judge that is the mentioned

above pixel having normal if one of difference is below the mentioned above threshold, and will judge that is the mentioned above pixel having poor if all the difference is larger than the mentioned above threshold, when data of the mentioned above pixel having is outputted when judged with the mentioned above pixel having being normal by the mentioned above defective pixel deciding circuit, and it is judged with the mentioned above pixel having being poor by the mentioned above defective pixel deciding circuit, inside of a plurality of the mentioned above interpolation data, a defective pixel compensator having and constituting an output data selection circuit (50) that outputs interpolation data of an interpolation direction judged by the mentioned above interpolation direction deciding circuit is provided, (B) in a defective pixel correcting method that amends a defective pixel contained in a picture that consists of a plurality of pixels, an interpolation data calculation step which computes a plurality of interpolation data using a plurality of picture element pairs which are in a symmetric position focusing on the mentioned above pixel having among pixels located around pixel having in the mentioned above a plurality of pixels, an interpolation direction determination step that judges an interpolation direction using the mentioned above a plurality of picture element pairs, computing difference of data of the mentioned above pixel

having, and a plurality of the mentioned above interpolation data, respectively, and each of the difference is compared with a predetermined threshold, a defective pixel determination step will judge that is the mentioned above pixel having normal if one of difference is below the mentioned above threshold, and will judge that is the mentioned above pixel having poor if all the difference is larger than the mentioned above threshold, when data of the mentioned above pixel having is outputted when judged with the mentioned above pixel having being normal by the mentioned above defective pixel determination step, and it is judged with the mentioned above pixel having being poor by the mentioned above defective pixel determination step, inside of a plurality of the mentioned above interpolation data, a defective pixel correcting method including an output data selection step that outputs interpolation data of an interpolation direction judged by the mentioned above interpolation direction determination step is provided.

[0020]

[Embodiment of the invention] Next, the defective pixel compensator and method of this invention are explained with reference to an attached drawing. Drawing 1 is a block diagram showing the 1st example of this invention.

Drawing 2 is a drawing for explaining operation of the 1st example of this invention. Drawing 3 is a drawing showing the quality decision result by the 1st example of this invention. Drawing 4 is a drawing showing the defective pixel correction results by the 1st example of this invention. Drawing 5 is a drawing showing the quality decision result by the 1st example of this invention. Drawing 6 is a drawing showing the defective pixel correction results by the 1st example of this invention. Drawing 7 is a block diagram showing the 2nd example of this invention. Drawing 8 is a drawing showing the peripheral pixel used in the 2nd example of this invention. Drawing 9 is a drawing for explaining operation of the 2nd example of this invention. Drawing 10 is a drawing showing the quality decision result by the 2nd example of this invention. Drawing 11 is a drawing showing the defective pixel correction results by the 2nd example of this invention.

[0021] <1st example> In the 1st example shown on drawing 1, as shown on drawing 13, 3 pixel a, b, c, of the front (above) line of the pixel having x, 3 pixel d, e, f of a back (below) line, are used as a peripheral pixels. The data of the pixel having x is inputted into the defective pixel deciding circuit 10 in drawing 1. The defective pixel deciding circuit 10 judges whether the pixel having x is a defective pixel using the data of the pixel having x, and the mentioned below

interpolation data HD1-HD3. The concrete composition and operation of the defective pixel deciding circuit 10 are mentioned below.

[0022] The data of peripheral pixel a-f is inputted into the interpolation data calculation circuit 40 and the interpolation direction deciding circuit 30 one by one. The interpolation data calculation circuit 40 is computing (b+e)/2 for interpolation data HD1, computing (c+d)/2 for interpolation data HD2 and computing (a+f)/2 for interpolation data HD3.

These interpolation data HD1-HD3 is inputted into the defective pixel deciding circuit 10 and the output data selection circuit 50. The direction that connects the interpolation direction V and the peripheral pixels c and d for the direction that connects the interpolation direction L and the peripheral pixels b and e for the direction that connects the peripheral pixels a and f is the interpolation direction R. Interpolation data HD1, HD2, HD3 are interpolation data of the interpolation direction V, R, L, respectively.

[0023] The interpolation direction deciding circuit 30 is provided with the correlativity evaluation value calculation part 301 and the maximum primary detecting element 302. First, the correlativity evaluation value calculation part 301 calculates the interpolation direction V, R, L, the absolute values ?

V (=|b-e|), ? R (=|c-d|), ? L (=|a-f|) of the difference of each peripheral pixel. And correlativity evaluation value RF1 is computed by calculating 100-? V, calculating 100-? R for correlativity evaluation value RF2 and calculating 100-?L for correlativity evaluation value RF3. The correlativity evaluation values RF1-RF3 are inputted into the maximum primary detecting element 302. The maximum primary detecting element 302 judges what has the largest value as correlativity being the highest among the correlativity evaluation values RF1-RF3, and outputs the interpolation direction selection signal Dir that shows either of the interpolation directions V, R, L. When 2 or all of the correlativity evaluation values RF1-RF3 is equal, priority V>R>L determines an interpolation direction.

[0024] The output data selection circuit 50 is provided with the peripheral pixel data selection circuit 2 in conventional drawing 12 and the 1st switch circuit 501 that is the same composition.

The output data selection circuit 5 in conventional drawing 12, and the 2nd switch circuit 502 that is the same composition, interpolation data HD1 is inputted into the terminal of inside most the upper part of a drawing of the 1st switch circuit 501, interpolation data HD2 is inputted into the terminal of the center of the inside of a drawing of the 1st switch circuit 501, and interpolation data HD3 is inputted into the

terminal of the inside bottom of a drawing of the 1st switch circuit 501. The 1st switch circuit 501 has embraced the interpolation direction selection signal Dir, shifts and is selectively connected to that terminal.

[0025] On the other hand, the output of the 1st switch circuit 501 is inputted into the terminal of the 2nd switch circuit 502 (drawing lower part) . The data of the pixel having x is inputted into another (drawing upper part) terminal of the 2nd switch circuit 502. The 2nd switch circuit 502 has embraced the quality decision signal S supplied from the defective pixel deciding circuit 10, shifts and is selectively connected to that terminal.

[0026] The defective pixel deciding circuit 10 is provided with the difference value calculation part 101, the size comparing element 102, AND circuit 103. The difference value calculation part 101 computes the absolute values ? 1 (=|x-HD1|), ? 2 (=|x-HD2|), ? 3 (=|x-HD3|) of each difference of the data of the pixel having x, and the interpolation data HD1-HD3. The predetermined threshold T is inputted into the size comparing element 102, and size comparison of the difference values ? 1-? 3 and the threshold T is carried out, respectively, if the difference values ? 1-? 3 are below the threshold T, a low will be outputted, and if the size comparing

element 102 has the difference values ? 1-? 3 larger than the threshold T, it will output a high.

[0027] AND circuit 103 outputs the quality decision signal S by taking the logical product of the output of the size comparing element 102. The quality decision signal S will serve as a low that shows a normal, if at least one of the difference values ? 1-? 3 is a low, and if all the difference values ? 1-? 3 are high, it will serve as a high that shows a poor. This quality decision signal S is inputted into the 2nd switch circuit 502 of the output data selection circuit 50.

[0028] The 2nd switch circuit 502 switches the terminal to connect according to the quality decision signal S. That is, if normal, it will connect with the drawing side, the data of the pixel having x is outputted as it is, if poor, it will connect with the drawing side and the interpolation data (either HD1-HD3) from the 1st switch circuit 501 will be outputted. A defective pixel will be amended by the above to the normal pixel generated by interpolation.

[0029] Next, by composition of this invention explained above, even if a poor grade is a small defective pixel, it explains that it can amend good. Here, the poor grade of the pixel Q presupposes that the original image data shown on small drawing 21 is inputted into the defective pixel compensator of drawing 1.

Drawing 2 is surrounded as the solid line of drawing 21, level 5 pixels is vertical, the correlativity evaluation values RF1-RF3 (naming generically RF) and the interpolation data HD1-HD3 (naming generically HD) to each pixel in the range of 6 pixels are shown. In the interpolation direction V, RF2, HD2, and the interpolation direction L, RF1, HD1 and the interpolation direction R, RF3, HD3.

[0030] Drawing 3 shows the decision result by the defective pixel deciding circuit 10 when the threshold T is set to 30. In drawing 3, the pixel by which it judged that O is normal, and x are the pixels judged that are poor. Since the pixel Q has the difference values ? 1-? 3 (=32) of the data (=40) of the pixel Q, and the interpolation data HD1-HD3 (=8) all larger than the threshold T (=30), it is judged with it being poor. On the other hand, although for example, the pixel P has the difference values ? 1, ? 3 (=42, 55) of the data (=70) of the pixel P, and interpolation data HD1 of the interpolation directions V, L, HD3 (=28, 15) larger than the threshold T (=30), since the difference value ? 2 (=15) of interpolation data HD2 (=55) of the interpolation direction R is smaller than the threshold T (=30), it is judged with it being normal. Other pixels are also the same, and as shown on drawing 3, it judges that the pixel Q is poor.

[0031] Drawing 4 shows the correction results of the defective pixel that is an output of the output data selection circuit 50. The pixel having data x is outputted as it is except all pixel Q, and, as for the pixel Q, interpolation data HD1 (=8) is outputted instead of original picture matter data. Thus, according to this invention, the pixel that is not a defective pixel like drawing 27 is amended accidentally, it will not shift from an original value and the defective pixel Q will be amended like drawing 20.

[0032] Drawing 5 is a decision result by the defective pixel deciding circuit 10 when the threshold T is set to 20, and drawing 6 is the correction results at that time. Also, the result same as 20 as drawing 3 and drawing 4 is brought in the threshold T. Thus, according to this invention, even if it makes the threshold T of a quality decision quite small, a possibility of judging that a normal pixel is poor is low. Thus, a poor grade becomes possible amending a small pixel. Whether the threshold T can be made how far small can make the threshold T small substantially conventionally, although it changes with values of original picture matter data.

[0033] <2nd example> The pixels g and h by which the 2nd example shown on drawing 7 adjoins the right and left of the pixel having x in the pixel used as a peripheral pixel as shown on drawing 8, in addition

the pixel having x are made to perform a judgment and amendment of whether to be a defective pixel. For convenience, the same numerals as drawing 1 are attached and explained to each block of drawing 7.

[0034] The data of peripheral pixel a-h is inputted into the interpolation data calculation circuit 40 and the interpolation direction deciding circuit 30 one by one. The interpolation data calculation circuit 40 computing (b+e)/2 for interpolation data HD1, computing (g+h)/2 for interpolation data HD2, computing (c+d)/2 for interpolation data HD3 and computing (a+f)/2 for interpolation data HD4. These interpolation data HD1-HD4 are inputted into the defective pixel deciding circuit 10 and the output data selection circuit 50. The direction that connects the peripheral pixels g and h is the interpolation direction H.

[0035] The correlativity evaluation value calculation part 301 of the interpolation direction deciding circuit 30, the interpolation direction V, H, R, L, the absolute values ? V, ? H, ? R, ? L of the difference of each peripheral pixel are calculated, and the correlativity evaluation values RF1-RF4 are computed. The maximum primary detecting element 302 judges what has the largest value as correlativity being the highest among the correlativity evaluation values RF1-RF4, and outputs the interpolation direction selection signal Dir that shows either the interpolation direction V, H,

R, L. The 1st switch circuit 501 of the output data selection circuit 50 chooses either of the interpolation data HD1-HD4 according to the interpolation direction selection signal Dir.

[0036] The difference value calculation part 101 of the defective pixel deciding circuit 10 computes the absolute values ? 1-? 4 of each difference of the data of the pixel having x, and the interpolation data HD1-HD4. The size comparing element 102, AND circuit 103 operate like the 1st example, and output the quality decision signal S. The 2nd switch circuit 502 of the output data selection circuit 50 switches the terminal to connect according to the quality decision signal S.

[0037] Drawing 9 is surrounded as the solid line of drawing 14, level 5 pixels is vertical, the correlativity evaluation values RF1-RF4 (naming generically RF) and the interpolation data HD1-HD4 (naming generically HD) to each pixel in the range of 6 pixels are shown. In interpolation direction V, RF1, HD1, and the interpolation direction H, RF3, HD3, and the interpolation direction L, RF2, HD2, and the interpolation direction R, RF4, HD4.

[0038] Drawing 10 shows the decision result by the defective pixel deciding circuit 10 when the threshold T is set to 10. Drawing 11 shows the correction results of the defective pixel that is an output of the output

data selection circuit 50. As are shown on drawing 10, and it judges that the pixel Q is poor also as 10 still smaller than the case of the 1st example and the threshold T is shown on drawing 11, the defective pixel Q is amended.

[0039] This invention is not limited to this example described above, and can be variously changed in the range that does not deviate from the gist of this invention. This invention can consist of both hardware and software. This invention can detect the noise included in the signal by which 2D array was carried out, and it can be used for it also as a noise limiter circuit replaced with the interpolation signal that computed this from the surrounding signal.

[0040]

[Effect of the invention] As explained in details above, the defective pixel compensator and method of this invention, the interpolation data calculation circuit (step) that computes a plurality of interpolation data using a plurality of picture element pairs which are in a symmetric position focusing on pixel having among the pixels located around the pixel having in a plurality of pixels, the interpolation direction deciding circuit (step) that judges an interpolation direction using a plurality of picture element pairs, computing the difference of the data of pixel having, and a plurality of interpolation data, respectively, and each

of the difference is compared with a predetermined threshold, the defective pixel deciding circuit (step) will judge that is pixel having normal if one of difference is below a threshold, and will judge that is pixel having poor if all the difference is larger than a threshold, when judged with pixel having being normal by the defective pixel deciding circuit (step), when the data of pixel having is outputted and it is judged with pixel h aving being poor by the defective pixel deciding circuit (step), since the output data selection circuit (step) that outputs the interpolation data of the interpolation direction judged by the interpolation direction deciding circuit (step) among a plurality of interpolation data was had and constituted, even if a poor grade is a small defective pixel, it can amend good.

[Brief description of the drawings]

[Drawing 1] is a block diagram showing the 1st example of this invention.

[Drawing 2] is a drawing for explaining operation of the 1st example of this invention.

[Drawing 3] is a drawing showing the quality decision result by the 1st example of this invention.

[Drawing 4] is a drawing showing the defective pixel correction results by the 1st example of this invention.

[Drawing 5] is a drawing showing the quality decision result by the 1st example of this invention.

[Drawing 6] is a drawing showing the defective pixel correction results by the 1st example of this invention.

[Drawing 7] is a block diagram showing the 2nd example of this invention.

[Drawing 8] is a drawing showing the peripheral pixel used in the 2nd example of this invention.

[Drawing 9] is a drawing for explaining operation of the 2nd example of this invention.

[Drawing 10] is a drawing showing the quality decision result by the 2nd example of this invention.

[Drawing 11] is a drawing showing the defective pixel correction results by the 2nd example of this invention.

[Drawing 12] is a block diagram showing a conventional example.

[Drawing 13] is a drawing showing the peripheral pixel used by the 1st example and conventional example of this invention.

[Drawing 14] is a drawing showing an example of the original image data in which the large defective pixel of the poor grade is contained.

[Drawing 15] is a drawing for explaining operation of the conventional example in the case of the original image data shown on drawing 14.

[Drawing 16] is a drawing for explaining operation of the conventional example in the case of the original image data shown on drawing 14.

[Drawing 17] is a drawing showing the quality decision result by the conventional example in the case of the original image data shown on drawing 14.

[Drawing 18] is a drawing showing the defective pixel correction results by the conventional example in the case of the original image data shown on drawing 14.

[Drawing 19] is a drawing showing typically the original image data shown on drawing 14.

[Drawing 20] is a drawing showing typically the defective pixel correction results by the conventional example in the case of the original image data shown on drawing 14.

[Drawing 21] is a drawing showing an example of the original image data in which the small defective pixel of the poor grade is contained.

[Drawing 22] is a drawing for explaining operation of the conventional example in the case of the original image data shown on drawing 21.

[Drawing 23] is a drawing for explaining operation of the conventional example in the case of the original image data shown on drawing 21.

[Drawing 24] is a drawing showing the quality decision result by the conventional example in the case of the original image data shown on drawing 21.

[Drawing 25] is a drawing showing the defective pixel correction results by the conventional example in the case of the original image data shown on drawing 21.

[Drawing 26] is a drawing showing typically the original image data shown on drawing 21.

[Drawing 27] is a drawing showing typically the defective pixel correction results by the conventional example in the case of the original image data shown on drawing 21.

[Description of numerals]

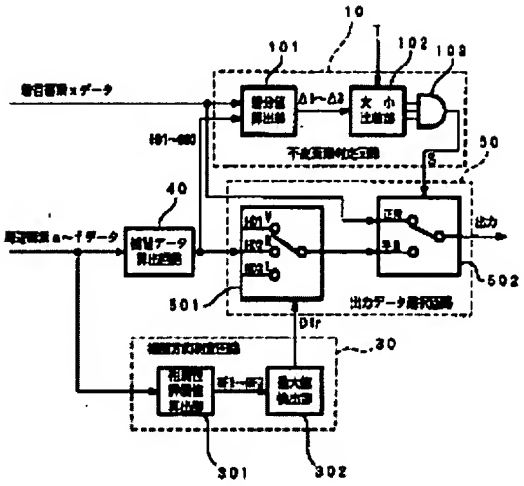
10 Defective pixel deciding circuit

30 Interpolation direction deciding circuit

40 Interpolation data calculation circuit

50 Output data selection circuit

Drawing 1



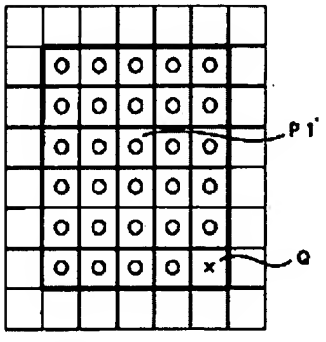
Drawing 2

	RF	HD	RF	HD	RF	HD	RF	HD	RF	HD
V	100	10	95	13	85	18	60	30	40	40
R	100	10	100	10	95	13	85	18	60	30
L	85	13	85	18	60	30	40	40	30	45
V	60	30	45	38	40	40	40	40	60	35
R	85	18	60	30	45	38	45	43	65	53
L	45	38	43	40	40	40	55	33	85	18
V	40	40	55	38	85	28	85	33	38	39
R	55	35	55	48	80	15	60	50	35	48
L	50	35	80	20	100	15	83	17	58	29
V	70	25	43	37	38	39	38	29	53	32
R	75	53	53	45	38	39	53	32	83	17
L	83	17	58	29	43	17	38	39	38	39
V	38	39	43	34	75	19	83	12	58	24
R	45	34	78	19	93	12	100	8	100	8
L	45	34	38	39	45	34	90	35	83	12
V	85	14	100	8	100	8	100	8	100	8
R	100	8	100	8	100	8	100	8	100	8
L	85	24	88	14	100	8	100	8	100	8

P1

Q

Drawing 3



O：正常

×：不良

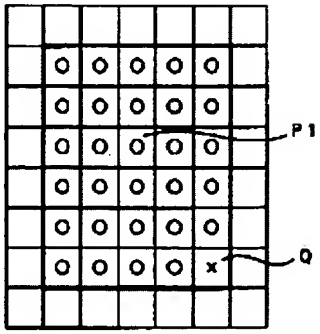
Drawing 4

10	10	10	10	10	10	10
10	10	10	10	10	15	35
10	10	15	25	50	70	80
25	50	65	70	70	65	25
60	70	60	30	15	8	8
40	20	8	8	8	8	8
8	8	8	8	8	8	8
8	8	8	8	8	8	8

P1

Q

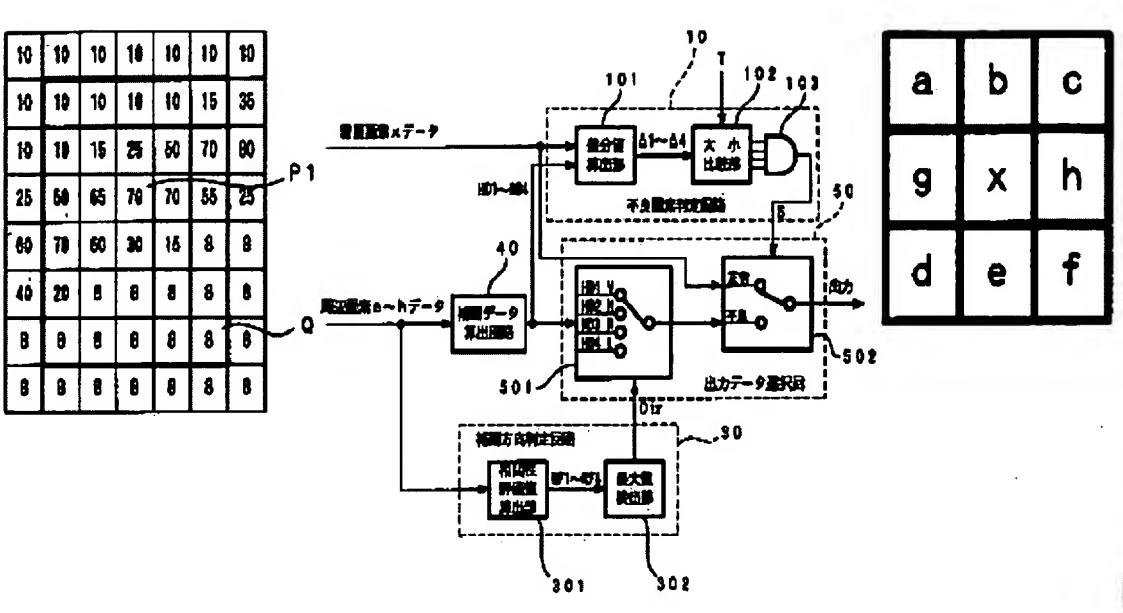
Drawing 5



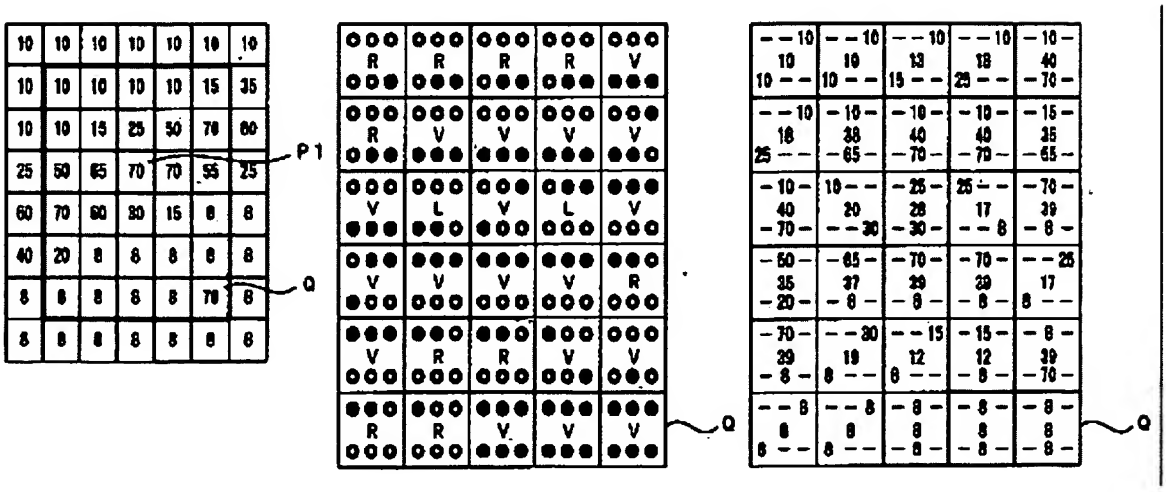
O：正常

×：不良

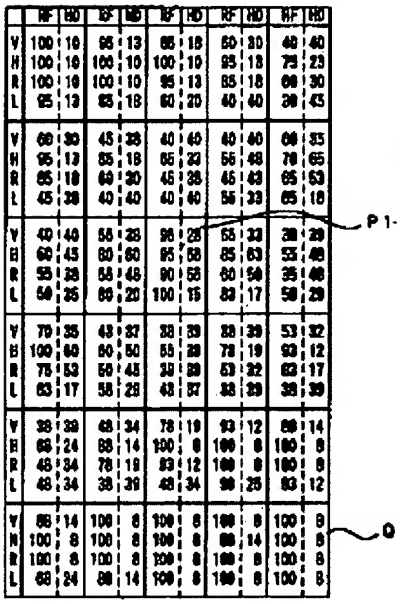
Drawing 6 Drawing 7 Drawing 8



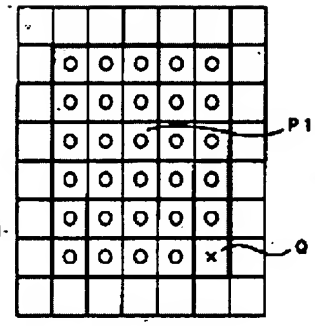
Drawing 14 Drawing 15 Drawing 16



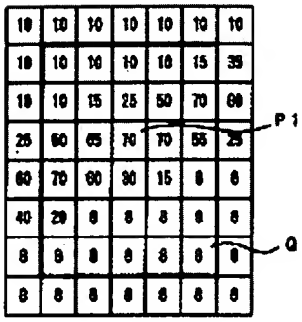
Drawing 9



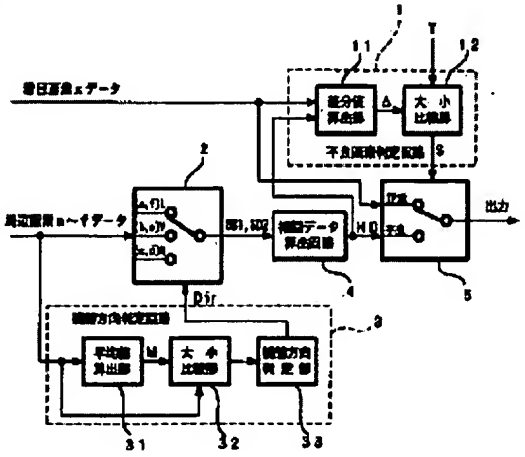
Drawing 10



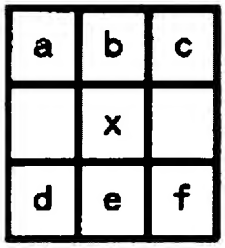
Drawing 11



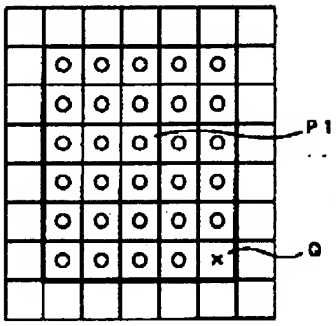
Drawing 12



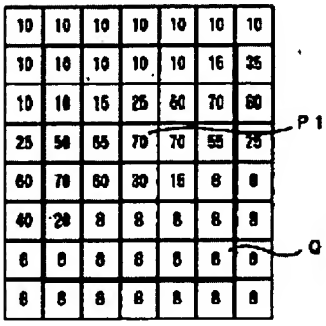
Drawing 13



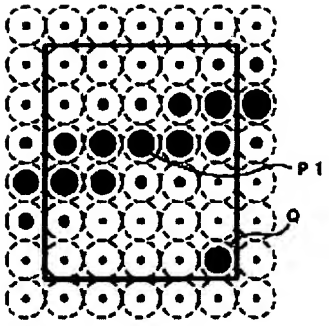
Drawing 17



Drawing 18

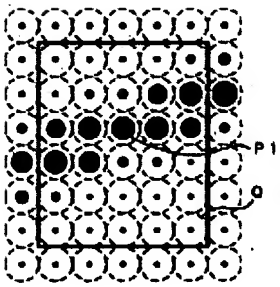


Drawing 19

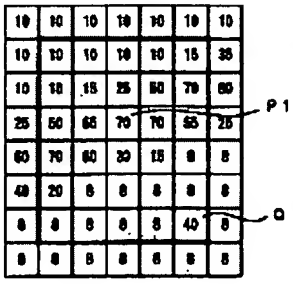


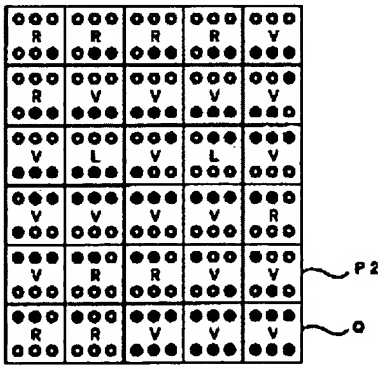
Drawing 22

Drawing 20

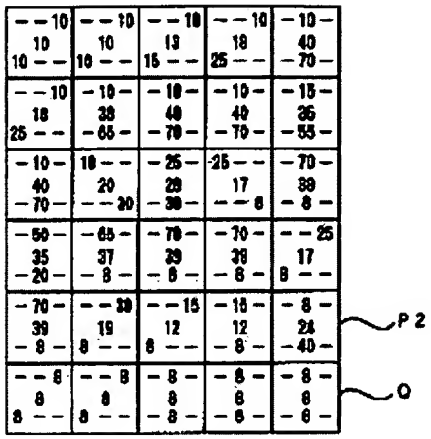


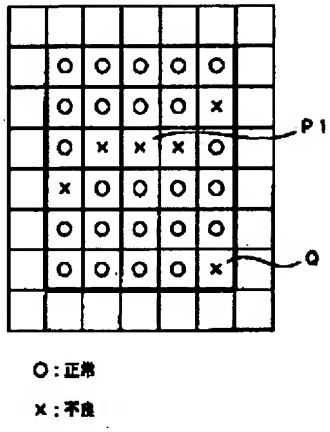
Drawing 21

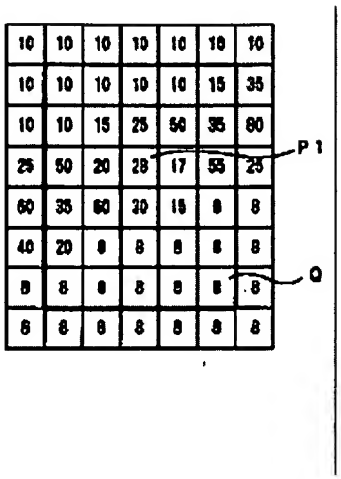
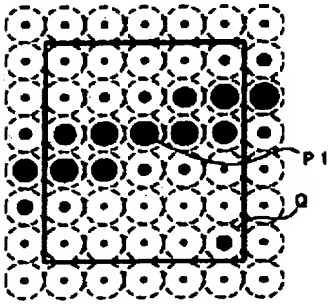
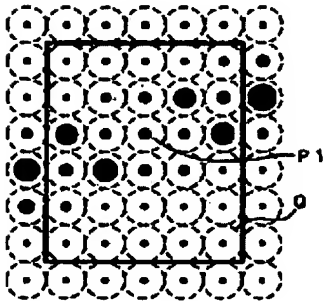




Drawing 23 Drawing 24 Drawing 25







Drawing 26 Drawing 27